BELLCOMM, INC.

SUBJECT: CSM Program Management Review at North American Aviation, January 16, 1967 - Case 330

DATE: January 23, 1967

FROM: P. F. Sennewald

ABSTRACT

CSM's 012 and 017, including the Mission Control Programmer, appear to be free of significant impact although several relay problems persist in the Program. SCS design changes will be made to improve CSM and CSM/LM thrust vector control stability margins. While all CSM 008 anomalies are "effectively" resolved, Dr. Shea is concerned about bacterial contamination of the potable water supply. The deletion of SPS propellant line heaters on Block II will be reviewed to ensure that mission constraints do not result. MSC and NAA are not agreed on three items concerning use of CSM 012 on AS-204 (fuel cell isolation, SM RCS budget, and CM RCS early activation). The deletion of the G&N on-board, self-check software has increased the available memory on the CSM and the LM. Some stress corrosion failures of titanium in freon have been experienced at MSC; however, available data is incomplete and inconsistent. NAA is now evaluating the hardware changes required to eliminate the "grossly inadequate" capability for EVA on Block II CSM's; the major problems appear to be couch and hatch interference with crew ingress/egress.

Also discussed were high gain antenna checkout, docking hardware availability for zero-G programs and crew training, the development of criteria for reuse of flight hardware, a NAA review of checkout procedures, and inverter transistor failures.

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MEMORANDUM FOR FILE

1.0 Introduction

The CSM Program Management Review and Joint Change Control Board meeting were held at NAA on January 16, 1967. The senior representatives present were Messrs. J. Shea and G. Jeffs. This memorandum provides a short summary of the more significant items discussed.

2.0 Summary

2.1 High-Gain Antenna Checkout

R. W. Williams, MSC, will resolve in a meeting with KSC the location of the principal functional tests of this antenna; i.e., NAA or KSC. NAA proposed only minimal electrical and mechanical interface tests at NAA without mating the antenna to the SM since it is shipped separately.

2.2 Relay and Mission Control Programmer Review

Status reports were given on the following items:

2.2.1 Solder Ball Relay Contamination in MCP

All suspect relays have been replaced in CSM 017 and all suspect relays which are critical have been replaced in CSM 020.

2.2.2 Clipped Lead Relay Problem

Previous reports of failures due to the clipping of relay leads were erroneous. The failures were due to external circuitry problems.

2.2.3 Time Delay Errors

The probable cause (internal transients) of the error in the CM-SM separation timer reported at the last Program Management Review has been identified and a fix (added capacitors) is being implemented.

2.2.4 "Polymer" Contamination of PCVB* Relay Contacts

The contamination has been found to be machine shop oil. A change in fabrication processes contaminated one lot. While there are several relays from this lot in the CSM 012 Master Event Sequence Controller, it was reported that only two have a possible impact on crew safety if only the failure of the suspect relays is considered.# The A and B paths of the Auto Abort Enable circuitry each contain one suspect relay. It was stated that since the function can be enabled manually, no change will be made. However, a review of the circuitry since the meeting indicates that the manual backup which was referenced operates the same faulty relay!

2.2.5 Golden G Relay Failures in the SCS

These failures (both open and closed) in Block I and II are still not explained and are not reproducible after relay teardown. Since the SCS was said to have full crew safety redundancy, no changes were recommended for CSM 012. Minneapolis-Honeywell will provide a Failure Mode Effects Analysis on January 19. This will be a Flight Readiness Review agenda item for AS-204.

2.2.6 CSM 017 MCP Redundancy Checks

This MCP has received a 100% check of its redundant capabilities by the subcontractor. The same check will be repeated at KSC as late as possible before launch.

2.3 Extra Vehicular Capability Report

NAA is in the midst of evaluating the changes requested by MSC to provide a Block II EVA capability. Changes in the following areas are involved:

a) Side access hatch - the hatch simply was not designed for EVA and is one of the two major problems.

b) Crew couch and struts - current couch configuration is simply "in the way" and represents the other major problem.

c) Handholds and foot restraints - clearance with parachute lines will have to be assured.

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*Pyro Continuity Verification Box

#That is, simultaneous failures in other subsystems were not considered.

d) ECS and cryogenic supply - cannot meet repressurization and depressurization requirement without changes.

e) Training equipment - this may be the pacing item after EVA hardware changes are defined.

Dr. Shea emphasized that the Block II EVA capability is grossly inadequate and that CSM 101 cannot fly unless EVA capability is acceptable. He also noted that the current troubles in the docking hardware underlined the need for an EVA capability. He also emphasized the need for a "hard look" at the docking interface problems to make sure the right approach is being taken.

2.4 Docking Hardware for Crew Training and Zero-G Program

NAA is updating mockup 27A hardware to a current configuration for the zero-G program. They will also review the hardware available to supply a complete second set for crew training. Configuration difference data on the docking probe was also presented.

2.5 SPS Thermal Management

The Block II SPS thermal management system is passive except for heaters mounted on the engine. Additional heaters are used on Block I on the propellant lines. Dr. Shea asked NAA to review this change as he does not want to run the risk of attitude constraints due to the deleted heaters. MSC (J. Craig) will also review this change.

2.6 Checkout Review

NAA will provide a review of checkout procedures on February 6. The scope of this review was defined previously.

2.7 CSM 012 Mission Agreements

NAA presented three items which represent the only items of disagreement between NAA and MSC relative to the use of CSM 012 on AS-204. These are:

a) CM RCS Premature Activation - NAA proposes pressurization to the isolation valves and the use of downstream pressure sensors (from the single helium sensor) to verify the redundant RCS capability for reentry in case of a helium sensor failure.

b) SM RCS Redline Budget - NAA contends that budget entries for mixture ratio allowance (20 lbs), operational reserve (40 lbs), and fill gaging error (60 lbs) should not be included.

c) Fuel Cell Isolation During Low Load Periods - NAA recommends isolation of one fuel cell (i.e., removal from the D. C. busses) whenever the electrical load is less than 1700 watts. The concern is about over-voltage at such low loads. However, there is some concern as to the length of time a fuel cell can be kept isolated (24 hours seems to be the rule of thumb) and the speed with which an isolated cell can pick up its share of the load when returned to the bus.

2.8 CSM and CSM/LM Modal Data

The decision was made to make design changes (on CSM 101 and subs) in the SCS to provide increased margin for thrust vector control stability for docked and undocked configurations. While 30 days are required to make the changes, it appears the schedule impact will be much less.

2.9 Inverter Transistor Failures

CSM 017 now has one inverter with one pair of unscreened transistors. Confidence has increased considerably in the screening test. Nevertheless, the length of the screen test will be increased for CSM's after 012.

2.10 CSM 008 Anomalies

Dr. Shea considers all anomalies "essentially closed" even though some are still officially unresolved (e.g., failures of fuel cells, the VHF receiver, and the ECS glycol pumps). However, he reiterated the crew's concern about the ECS cobra cable; they have not yet seen a unit which has not failed. Also, Dr. Shea is concerned about bacterial contamination of the potable water supply.

2.11 Titanium Stress Corrosion Failures Due to Freon

MSC has had laboratory stress corrosion failures of 6Al-4V titanium due to freon MF. NAA has attempted to reproduce these failures but with one exception have not been successful. The exception was with Freon MF which had HCl bubbled through it. The Martin Company is reported to be able to explain both N_2O_4 and methanol stress corrosion failures as a result of free chlorine in solution.

It was concluded that the available data is too inconsistent to support serious concern yet.

2.12 Guidance and Navigation Status

Dr. Shea reported the results of a recent meeting at MIT. The availability of tapes with which to generate flight

ropes for AS-258 is now set as June 1 with efforts being made to advance it to May 1. Also, some 2500-2800 words of memory capacity were made available by decisions to remove computer self-check procedure capabilities from the software. The remaining G&N interface checkout capability will be removed before flight from the erasable memory. The resultant "pads" in the memory are about 2500 words for the CM and 3500 words for the LM.

2.13 Reuse of Flight Hardware

NAA is developing criteria for the reuse of flight hardware. This is timely in light of the recent decision to buy three additional CSM's.

2031-PFS-dly

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